

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Problem Image Mailbox.**

1

1 Fluid Storage Apparatus

2

3 Technical Field

4

5 The present invention relates to fluid storage
6 apparatus, in particular, but not exclusively, to
7 apparatus for the disruption and storage of cellular
8 fluids.

9

10 Background

11

12 A knowledge of the constituent components of the
13 cells of cellular fluids, such as deoxyribonucleic
14 acid, are of great importance to the understanding
15 of how such cells function. In order to analyse
16 these components from the cells it is necessary to
17 cause disruption of the cells. This basically means
18 that the walls of the cells are broken down, thus
19 allowing the constituent components to be removed
20 for analysis.

21

1 Disrupted cellular fluids, that is, cellular fluids
2 in which the cell walls have burst, are
3 conventionally stored in a pre-sterilised sealed
4 container which may be further stored in a plastic
5 bag and refrigerated prior to use. Storing
6 disrupted cellular fluids in this manner however,
7 means taking a sample of the disrupted cellular
8 fluid and placing it in the container. This
9 handling of the sample greatly increases the risk of
10 contamination and degradation of the sample.
11 Furthermore, the container used to store the sample
12 is often sterilised for re-use, which is expensive
13 and further increases the risk of contamination and
14 degradation of the sample.

15

16 It is an object of the present invention to provide
17 a fluid apparatus for the disruption and storage of
18 cellular fluids which obviates or mitigates one or
19 more of the disadvantages referred to above.

20

21 Summary of Invention

22

23 According to a first aspect of the present invention
24 there is provided a fluid storage apparatus
25 comprising a first container having a first chamber
26 capable of being filled with a fluid, a second
27 container having a second chamber adapted to receive
28 fluid from said first chamber, the second container
29 having a piston means slideably receivable within
30 said first chamber of said first container, wherein,
31 on insertion of said piston means into said first

3

1 chamber of said first container, fluid is displaced
2 from said first chamber to said second chamber.

3

4 Preferably the piston means and the second container
5 are integrally formed.

6

7 Preferably the piston means has a bore which fluidly
8 communicates with the first and second chambers.

9

10 Preferably the bore has a first portion having a
11 first diameter, and a second portion having a second
12 diameter which is smaller than the first diameter.

13

14 Preferably the first portion of the bore is adjacent
15 the second chamber and the second portion of the
16 bore is remote from the second chamber.

17

18 Preferably the fluid storage apparatus further
19 comprises a sealing means adapted to seal the first
20 and second containers together.

21

22 Preferably the first and second containers are
23 adapted to seal together as the fluid is displaced
24 to the second chamber.

25

26 Preferably at least one portion of the second
27 chamber is adapted to allow fluid to be removed
28 therefrom.

29

30 Preferably the fluid storage apparatus further
31 includes cutting means adapted to remove a part of

4

1 the apparatus such that the stored fluid may be
2 removed from the second chamber.

3

4 Preferably the fluid storage apparatus is
5 disposable.

6

7 Brief Description of the Drawings

8

9 Embodiments of the present invention will now be
10 described, by way of example only, with reference to
11 the accompanying drawings, in which:-

12

13 Fig. 1 is a side view of a first embodiment of a
14 fluid storage apparatus in an initial position,
15 Fig. 2 is a side view of the fluid storage apparatus
16 of Fig. 1 in a storage position,
17 Fig. 3 is a side view of a second embodiment of a
18 fluid storage apparatus in an initial position, and
19 Fig. 4 is a side view of the fluid storage apparatus
20 of Fig. 3 in a storage position.

21

22 Detailed Description

23

24 Referring to Figs. 1 and 2 of the drawings, a fluid
25 storage apparatus 10 comprises a first container 12
26 having a first chamber 14 capable of being filled
27 with a volume of cellular fluid, and a second
28 container 16 having a second chamber 18 and a piston
29 20. A cellular fluid is considered here as being a
30 fluid which is comprised of a large number of cells.
31 For example biological or man-made materials, such
32 as blood, tissue homogenate and saliva.

1

2 The piston 20 and the second container 16 are
3 integrally formed.

4

5 The piston 20 has a central bore 26 which allows
6 fluid communication between the first and second
7 chambers 14 and 18 when in use.

8

9 The first container 12 is substantially cylindrical
10 and defines the first chamber 14, which has a first
11 portion 22 which is also substantially cylindrical,
12 and a second portion 24 located adjacent the first
13 portion 22 which is semi-spherical.

14

15 The second container 16 is again substantially
16 cylindrical and defines the second chamber 18 which
17 is also substantially cylindrical. The second
18 chamber 18 is adapted to store the cellular fluid
19 when the apparatus 10 is in use.

20

21 The second container 16 also comprises a piston 20
22 which extends in a longitudinal direction from the
23 second chamber 18. The piston 20 has a central bore
24 26. The bore 26 has a first portion 26a adjacent
25 the second chamber 18 and a second portion 26b
26 remote from the second chamber 18. The first
27 portion 26a has a first diameter and the second
28 portion 26b has a second diameter which is smaller
29 than the first diameter. The piston 20 is slidably
30 engageable with the first portion 22 of the first
31 container 12. The piston 20 and the first portion
32 22 are sized such that, when they are engaged with

6

1 one another, a seal is formed therebetween by virtue
2 an interference fit created between the side of the
3 piston 20 and the side of the first chamber 14. An
4 interference fit is considered here as meaning a
5 fixed connection between two components which arises
6 by virtue of friction between the two components.
7 Thus, once the piston 20 is at least partially
8 inserted in the first chamber 14, the first chamber
9 14, the second chamber 18 and the central bore 26
10 define a sealed volume, which prevents the
11 surrounding air from contaminating or degrading the
12 fluid in the apparatus 10.

13
14 The second chamber 18 may have a portion (not shown)
15 which is adapted to allow fluid to be removed
16 therefrom. For example, the second chamber 18 may
17 have a thinner wall portion which would allow the
18 insertion of a syringe for extraction of the fluid.

19
20 The typical volume of sample contained within the
21 fluid storage apparatus 10 is approximately 5 ml,
22 although other volumes may be used.

23
24 Prior to use the first and second containers 12 and
25 16 are sterilised.

26
27 In operation, the first chamber 14 of the first
28 container 12 is filled with a sample of cellular
29 fluid. The piston 20 is then inserted into the
30 first portion 22 of the first chamber 14 and the
31 first and second containers 12 and 16 are then urged

7

1 together by means of applying longitudinal forces A
2 and B to their respective end portions 28 and 30.

3
4 The first and second containers 12 and 16 are
5 brought together by a machine (not shown) which
6 applies the requisite amount of force to the end
7 portions 28 and 30.

8
9 As the first and second containers 12 and 16 are
10 brought together the cellular fluid contained in the
11 first chamber 14 is forced by the piston 20 through
12 the central bore 26 and into the second chamber 18.
13 Due to the sealing fit of the piston 20 and the
14 first chamber 14, no fluid can escape between the
15 piston 20 and the first chamber 14.

16
17 The longitudinal forces A and B are applied to the
18 end portions 28 and 30 of the first and second
19 containers 12 and 16 until all the cellular fluid
20 has been transferred from the first chamber 14 to
21 the second chamber 18. Typically, the first and
22 second containers 12 and 16 are brought together in
23 less than 1 millisecond.

24
25 The process of bringing the first and second
26 containers 12 and 16 together in the manner
27 described above causes the cells of the cellular
28 fluid to be disrupted. By forcing the piston 20
29 into the first portion 22 of the first chamber 14,
30 the cellular fluid contained within the first
31 chamber 14 is pressurised and is forced through the
32 central bore 26 and into the second chamber 18. The

1 pressure required to disrupt the cellular fluid is
2 dependent upon the type of cellular fluid, but a
3 typical pressure is in the region of 40 kpsi (276
4 MPa) .

5

6 The differing diameters of the first and second
7 portions 26a and 26b of the central bore 26 of the
8 piston 20 creates a step which aids in the
9 disruption of the cellular fluid.

10

11 The shape, size and configuration of the central
12 bore 26 may also be varied depending on the type of
13 cellular fluid which is being stored.

14

15 The cells in the cellular fluid are disrupted by the
16 following mechanisms: (a) the boundary level cells
17 rupture due to the friction created at the wall of
18 the central bore 26 as the fluid passes through the
19 central bore 26, (b) the cell walls burst due to the
20 pressurisation of the fluid through the central bore
21 26, (c) the cells explode as they enter the second
22 chamber 18 due to the decrease in pressure and (d)
23 the outer cells burst on impact against the inner
24 wall of the end portion 30 of the second container
25 16.

26

27 Once the first and second containers 12 and 16 have
28 been brought together under the great pressure
29 applied, a seal is formed between the piston 20 and
30 the first portion 22 of the first chamber 14 by
31 virtue of the interference fit described above.
32 This seal allows the disrupted cellular fluid sample

1 to be stored safely and prevents degradation or
2 contamination of the sample.

3
4 When the disrupted cellular fluid is to be analysed,
5 a syringe, or the like, is inserted through adapted
6 wall portion (not shown) and the fluid is removed.
7 Alternatively, the fluid storage apparatus 10 may
8 further include a cutting means (not shown) which
9 may be used to simply cut open the apparatus 10,
10 thus allowing the fluid to be removed. The fluid
11 storage apparatus 10 is then disposed of, thus
12 avoiding the need for re-sterilisation.

13
14 The preferred material of construction of the fluid
15 storage apparatus 10 is plastic. The first and
16 second container 12 and 16 can be formed by any
17 suitable means, such as injection moulding, for
18 example. The second container 16 and the piston 20
19 are preferably moulded as one piece.

20
21 Figs. 3 and 4 of the drawings illustrate a second
22 embodiment of the present invention. Corresponding
23 similar features between the first embodiment and
24 the second embodiment have not been described,
25 although the same reference numerals have been used,
26 prefixed by the number 1.

27
28 The second container 116 also comprises a piston 120
29 which extends in a longitudinal direction from the
30 second chamber 118. The piston 120 has a central
31 bore 126. The bore 126 has a first portion 126a
32 adjacent the second chamber 118 and a second portion

10

1 126b remote from the second chamber 118. The piston
2 120 also has an orifice 126c at a far end of the
3 piston 120.

4

5 The first portion 126a has a first diameter and the
6 second portion 126b has a second diameter. The
7 first diameter is larger than the second diameter.

8

9 The piston 120 is slidably engageable with the first
10 portion 122 of the first container 112. The piston
11 120 has ridged sections 121 along its outer surface
12 123. The piston 120 and the first portion 122 are
13 sized such that, when they are engaged with one
14 another, a seal is formed therebetween by virtue an
15 interference fit created between the ridged sections
16 121 of the piston 120 and the side of the first
17 chamber 114.

18

19 The fluid storage apparatus 110 is operated in the
20 same manner as in the first embodiment.

21

22 When the disrupted cellular fluid is to be analysed,
23 the fluid may be removed from the apparatus 110 by
24 inserting a syringe into a syringe needle access
25 point 135 located adjacent the first chamber 114.

26

27 The fluid storage apparatus 10, 110 therefore
28 obviates or mitigates the disadvantages of previous
29 proposals by providing a fluid storage device which
30 allows the cellular fluid sample to be disrupted as
31 part of the sealing of the apparatus. The apparatus
32 both disrupts the cells of the fluid and stores the

11

1 fluid, thereby obviating the need for separate
2 disruption and storage. The fluid storage apparatus
3 10, 110 therefore avoids any contamination or
4 degradation of the cellular sample that
5 conventionally arises from the handling of a pre-
6 disturbed sample. Since the fluid storage apparatus
7 10, 110 is disposable, it also avoids the need for
8 sterilisation after use, which is expensive and
9 further increases contamination and degradation.

10
11 The fluid storage apparatus 10, 110 may, for
12 example, be used in the following procedures: cell
13 disruption, cell rupture, homogenisation, French
14 Press principle, single cell isolation, particle
15 size distribution, emulsifying and cell dispersion
16 of micro-organisms, human and animal tissues organs
17 and fluids, plant and soil. The fluid storage
18 apparatus 10, 110 may also be used, for example, in
19 the following applications: release, extraction and
20 isolation of intracellular organelles and including
21 cytoplasmic and membrane proteins and enzymes,
22 inclusion bodies and isolation, shearing and
23 splicing of deoxyribonucleic acids; and diagnosis of
24 microbial based diseases whereby one of the above
25 procedures is required.

26
27 Modifications and improvements may be made to the
28 above without departing from the scope of the
29 present invention. For example, although the fluid
30 storage apparatus 10, 110 is described as being used
31 with a cellular fluid, it should be appreciated that
32 the fluid storage apparatus 10, 110 could be used

12

1 with any biological or man-made material. Also,
2 although the central bore 26, 126 is shown to be
3 made up of stepped diameter sections 26a, 26b, 126a,
4 126b and 126c, it should be appreciated that the
5 central bore 26, 126 could be shaped in an
6 alternative arrangement. For example the bore could
7 be shaped to form a venturi section. Furthermore,
8 although the disruption of the cellular fluid is
9 described above as occurring from the pressurising
10 of the fluid through a single central bore 26, 126,
11 it should be appreciated that the disruption of the
12 cellular fluid could occur by any type of orifice,
13 or orifices. Also, although the typical volume of
14 cellular fluid sample contained within the fluid
15 storage apparatus is described above as being 5 ml,
16 it should be appreciated that the fluid storage
17 apparatus 10, 110 could be adapted to contain any
18 volume of sample. Furthermore, although the fluid
19 storage apparatus 10, 110 is described above as
20 being constructed from plastic, it should be
21 appreciated that the fluid storage apparatus 10, 110
22 could be made from alternative materials, including
23 metals such as steel or copper. Also, although the
24 sealing of the fluid storage apparatus 10, 110 is
25 described above as the result of an interference fit
26 between the first portion 22, 122 of the first
27 chamber 14, 114 and the piston 20, 120, it should be
28 appreciated that the fluid storage apparatus 10, 110
29 could be sealed by any suitable mechanical means.
30 For example, the apparatus 10, 110 could be sealed
31 by clamping the first and second containers 12, 112,
32 16, 116 together.

1
2 Furthermore, although the removal of the sample from
3 the fluid storage apparatus 10, 110 has been
4 described above as by means of access through a
5 portion of the second chamber 18, 118, it should be
6 appreciated that the sample could be removed from
7 the apparatus 10, 110 by providing a sealed screw
8 cap or a bayonet cap or the like at the end portion
9 30, 130 of the second container 16, 116.
10 Alternatively, the sample could be removed from the
11 apparatus 10, 110 by providing a frangible diaphragm
12 or the like on a wall of the second container 16,
13 116 that allows access to the sample once pierced.
14 Also, the sample could be removed from the apparatus
15 10, 110 by providing a hinged cap (flip-lid) or the
16 like on the second container 16, 116 that could be
17 swung open to allow access to the sample. The
18 sample could also be removed from the apparatus 10,
19 110 by providing on the second container 16, 116 a
20 plug or the like which could be pierced by a syringe
21 or the like. The sample could also be removed from
22 the apparatus 10, 110 by providing on the second
23 container 16, 116 a check valve which comprises a
24 sealing ball or the like which may be dislodged by a
25 syringe or the like when the sample is removed. The
26 sample could also be removed from the apparatus 10,
27 110 by providing on the second container 16, 116 a
28 weak portion which may be pierced by a syringe or
29 the like. The sample could also be removed from the
30 apparatus 10, 110 by providing on the second
31 container 16, 116 weak sections formed by grooves on
32 the body of the second container 16, 116 (either

14

1 internal or external) or the like which may be
2 'popped' or 'snapped' out of place allow access to
3 the sample. The sample could also be removed from
4 the apparatus 10, 110 by providing on the second
5 container 16, 116 a breakable spigot or the like on
6 the body of the second container 16, 116 which may
7 be 'snapped' off to allow access to the sample. The
8 sample could also be removed from the apparatus 10,
9 110 by providing on then end portion of the piston
10 20, 120 a breakable nozzle or the like which may be
11 'snapped' off to allow access to the sample. The
12 sample could also be removed from the apparatus 10,
13 110 by providing a drain device or the like which
14 may be inserted into the end portion 30, 130 of the
15 second container 16, 116. The sample could also be
16 removed from the apparatus 10, 110 by providing on
17 the second container 16, 116 an external tear-off
18 strip or the like which may, for example, be formed
19 around the circumference of the second container 16,
20 116. The external strip is then torn around the
21 circumference of the second container to allow
22 access to the sample. Alternatively, the tear-off
23 strip may be torn by a relative twisting motion
24 between the strip and the container 16, 116. Also,
25 the tear-off strip may be torn-off by providing a
26 key device or the like which links with the tear-off
27 strip allowing the strip to be removed upon a
28 turning action of the key. The external tear-off
29 strip may also include a sealing member provide
30 between the strip and the container 16, 116.
31 The sample could also be removed from the apparatus
32 10, 110 by providing on the second container 16, 116

15

1 a spin weld weak point or the like which allows a
2 portion of the container 16, 116 to be pulled or
3 twisted off. The sample could also be removed from
4 the apparatus 10, 110 by providing on the second
5 container 16, 116 a 'ring-pull' device or the like.
6 The sample could also be removed from the apparatus
7 10, 110 by providing on the second container 16, 116
8 a serrated cap portion or the like which is press-
9 fitted onto the end portion 30, 130 of the container
10 16, 116. The serrated cap portion is simply pulled
11 off when accessing the sample. The sample could
12 also be removed from the apparatus 10, 110 by
13 providing on the second container 16, 116 a sliding
14 gate portion or the like which is simply slid into
15 an 'open' position when accessing the sample. The
16 sample could also be removed from the apparatus 10,
17 110 by providing on the second container 16, 116 a
18 cap portion which may be pulled or slid into an
19 'open' position when accessing the sample. The
20 sample could also be removed from the apparatus 10,
21 110 by providing on the second container 16, 116 a
22 rotating cap portion which allows one or more fluid
23 extraction points to be aligned with the second
24 chamber 18, 118 of the container 16, 116 when
25 accessing the sample.

26
27 Although various methods have been described above
28 for the removal of the sample from the apparatus 10,
29 11 for analysis, it should be appreciated that the
30 sample may not necessarily need to be removed from
31 the apparatus 10, 110 in order for the sample to be
32 analysed. The apparatus 10, 110 may be constructed

16

1 of a material which is suitable for the sample to be
2 analysed whilst it is inside the second container
3 16, 116.
4
5 Finally, although the first and second containers
6 12, 112 and 16, 116 have been described above as
7 being brought together by a machine which applies
8 the requisite force to end portions 28, 128 and 30,
9 130, it should be appreciated that the first and
10 second containers 12, 112 and 16, 116 could be
11 brought together by any other suitable method.